COMMENT ON "The Health Effects of Passive Smoking", The Draft Report of the NHMRC Working Party, November 1995, National Health and Medical Research Council, Australia.

BY Jeffrey R Idle, PhD, CChem, FRSC
Professor in Medicine
Institute for Cancer Research and Molecular Biology
Medical Technical Research Centre
Norwegian University of Science and Technology
7005 Trondheim
Norway

tel.: 47-73598879
fax: 47-73590560
email: jeffrey.idle@ifk.unit.no

14 February 1996

PM3006558454

Source: https://www.industrydocuments.ucsf.edu/docs/hnwj0001

Using reasonable assumptions, it is possible to estimate the likely concentrations of ETS components that would be generated in, say, an Australian occupational environment. This is an important exercise because so little data have been collected on components of interest. Modelling of ETS can be based upon either the home or the workplace, where occupational densities (m^2 floorspace or m^3 air volume per person) have clearly understood minimum and maximum values. By this it is meant that no-one lives or works in a space of only $1m^2$ (*i.e.* ~2-$3m^3$air) or as great as $100m^2$ (*i.e.* 200-$300m^3$ air). For the purposes of modelling of ETS exposure, an air volume of $36m^3$ per person is used, equivalent to a "personal space" of 3m x 4m x 3m. Other reasonable assumptions regarding the workplace, for example, concern ventilation. Even without mechanical ventilation air is not static. Draughts through doors and windows give at least one complete air change in the working day, whilst mechanical ventilation, such as found in public buildings have 2-5 air changes per hour (ACH) (Guerin *et al.*, 1992). For the purpose of modelling, a value of only 1.0ACH will be used. In calculating time weighted averages (TWA) of ETS components for the purpose of evaluating human exposures, the following reasonable assumptions are made. Firstly, the proportion of cigarette smokers in the work environment mirrors the national prevalence of cigarette smokers. A

PM3006558455

Source: https://www.industrydocuments.ucsf.edu/docs/hnwj0001

figure of 25% will be used. Secondly, it will be assumed that smokers smoke continuously and on average at a rate of 15 cigarettes per 8 hour working day, equivalent to a consumption of 30 (one and a half packs) in an 16 hour waking day.

From the above it can be readily seen that each smoker will evolve ETS equivalent to 15 cigarettes into an air volume of $36m^3$ which is ventilated at a rate of 1.0ACH. Over an 8 hour working day each smoker will have "access" to $288m^3$ (36 x 1.0 x 8) of "personal" air. Since only one-in-four workers is a smoker, ETS will be dispersed into a total volume of $1152m^3$ or air. On this basis, ETS levels can be calculated, knowing the ETS yields (Tables 1 and 2) for each of 15 cigarettes smoked and the total air volume ($1152m^3$). For purposes of calculation simplicity, this volume will be reduced to $1000m^3$. ETS TWAs will simply model as ETS yield of component (μg per cigarette) x 15 ÷ $1000\mu gm^{-3}$. Such calculations are prudent inasmuch as they assume a high smoking rate, a low ventilation rate and an occupational density of one person per $36m^3$, *i.e.* about $12m^2$ floor space. It would be expected, if anything, for this model to **overestimate** ETS component levels.

The model assumes levels of smoking and ventilation, together with density of occupancy (m^3 per person). Currently available data on the yield of tobacco components into mainstream smoke, the experimentally determined sidestream to mainstream ratio for each component and the proportion of each component retained by the lungs are also employed. The monograph of Guerin *et al.* (1992) is an excellent compendium of field studies of ETS components. The IARC Monograph No. 38 (1986) is a standard source of component yields per cigarette, although it should be pointed out that the data are all derived from unfiltered Japanese, American and German brands and not from filtered Australian cigarettes. The so derived concentrations of ETS components can be compared with both the component concentrations that have been found in indoor air environments and the occupational exposure limits for these components, where such limits have been set by regulatory agencies. In this last regard, occupational exposure limits have been determined in Australia for many of the single components of ETS and are published in "Exposure Standards for Atmospheric Contaminants in the Occupational Environment", National Occupational Health and Safety Commission, Australian Government Publishing Service, Canberra (May, 1995).

Table 1 gives an analysis of each component that has been detected in indoor air. In cases where a comparison can be made between the calculated and determined levels, the agreement is broadly good. For example, the observed range of values of the high-yield component nicotine in indoor air is 0-199 μgm^{-3} and the calculated level from the model is 70 μgm^{-3}. Likewise for the low-yield components such as the nitrosamines, the model predicts exactly the observed concentrations in

PM3006558456

Source: https://www.industrydocuments.ucsf.edu/docs/hnwj0001

indoor air environments, thus inspiring confidence in the model. Using this novel approach it is readily seen that no component of tobacco smoke approaches the Australian occupational exposure limits and fall between one and six orders of magnitude below these limits which themselves have been carefully set to protect the health and safety of workers exposed to chemicals for 8 hours per day for up to 50 years. They are commonly derived by using the no observed effect levels (NOEL) in experimental animals and making a zero risk assessment based upon a further safety margin of 100. The historical trend of these values is downwards and there is a general, but not always specific, international consensus regarding their numerical values. When one discovers that the chemical components of ETS, both derived and experimentally determined, are always orders of magnitude below the occupational exposure limits, themselves set very stringently, there are clearly grounds on which to challenge the claim that ETS causes disease in nonsmokers. This is consistent with the epidemiological studies of ETS exposure, analysed by the US EPA and others, which report only a weak and nonstatistically significant association with lung cancer and heart disease.

Set against the background of chemicals to which we are all exposed in the late 20th century, using the Australian occupational environment as an example, the risk of ETS to human health can be considered as trivial. ETS is not a proven risk to human health.

signed _____ date 14 February 1996

Professor Jeffrey R Idle

PM3006558457

Source: https://www.industrydocuments.ucsf.edu/docs/hnwj0001

References

Fernandez-Salguero P, Hoffman SMG, Cholerton S, Mohrenweiser H, Raunio H, Rautio A, Pelkonen O, Huang J, Evans WE, Idle JR, Gonzalez FJ. A genetic polymorphism in coumarin 7-hydroxylation: sequence of the human *CYP2A* genes and identification of variant CYP2A6 alleles. *Am J Hum Genet* 1995; **57**: 651-660.

Guerin MR, Jenkins RA, Tomkins BA. The Chemistry of Environmental Tobacco Smoke: Composition and Measurement. Chelsea, Michigan, Lewis Publishers, 1992.

McCracken NW, Cholerton S, Idle JR. Cotinine formation by cDNA-expressed human cytochrome P450. *Med Sci Res* 1992; **20**: 877-878.

PM3006558458

Source: https://www.industrydocuments.ucsf.edu/docs/hnwj0001

TABLE 1 ETS component concentrations calculated for a typical workplace environment (using cigarette ETS yields), maximum Australian occupational exposure limits and observed ETS component concentrations

CONSTITUENT	Calculated concentration in air (A) $\mu g\ m^{-3}$	Occupational exposure limit (**Australia**) $\mu g\ m^{-3}$	Observed indoor air concentration (B) $\mu g\ m^{-3}$	COMMENT	Probable contribution of ETS to observed level $\frac{Ax100}{B}$
VAPOUR PHASE					
Carbon dioxide	3855	9,000,000	589,000 (0.03%)	>2,000-times below limit	0.7%
Carbon monoxide	803 (0.6ppm)	34,000	2,700-13,000 (2-10ppb)	42-times below limit Wide range of studies (See Guerin *et al.*, 1992)	6-30%
Acetic acid	21	25,000	-	1,190-times below limit	-
Hydrogen cyanide	1.1	11,000	-	10,000-times below limit	-
Nitrogen oxides ($NO + NO_2$)	33.2 (19.6ppb)	5,600 (for NO_2)	50-650 ppb	169-times below limit for NO_2 Wide range of studies	-
Formic acid	7.1	9,400	-	1,300-times below limit	-

PM3006558459

Source: https://www.industrydocuments.ucsf.edu/docs/hnwj0001

TABLE 1(CONT'D i)

CONSTITUENT	Calculated concentration in air (A) $\mu g\ m^{-3}$	Occupational exposure limit (Australia) $\mu g\ m^{-3}$	Observed indoor air concentration (B) $\mu g\ m^{-3}$	COMMENT	Probable contribution of ETS to observed level $\frac{Ax100}{B}$
Acetone	8.3	1,185,000	1160	142,000-times below limit No values for workplaces, except one hospital lobby	0.7%
Toluene	14.1	377,000	0.6-292	27,000-times below limit	4.8%-100%
Ammonia	5.3	17,000	-	3,200-times below limit	-
Formaldehyde	28.7	1,200	6-13,000 6-38	42-times below limit High levels due to formaldehyde resins "worst workplace atmospheres" (chosen by workers)	2-100% 76-100%
Acrolein	12.4	230	20	19-times below limit No values for workplaces except one hospital lobby	62%
1,3-Butadiene	4.2	[2,200,000]	(2.7-19)	520,000-times below limit No values for workplaces only bars/taverns	(22-100%)

PM3006558460

Source: https://www.industrydocuments.ucsf.edu/docs/hnwj0001

CONSTITUENT	Calculated concentration in air (A) $\mu g\ m^{-3}$	Occupational exposure limit $\mu g\ m^{-3}$	Observed indoor air concentration (B) $\mu g\ m^{-3}$	COMMENT	Probable contribution of ETS to observed level $\frac{Ax100}{B}$
Benzene	3.0	16,000	n.d.-18.3	5,300-times below limit Many studies, only one in offices	16-100%
Pyridine	5.0	[15,000]	(0.8-15.7)	3,000-times below limit No values for offices, but four restaurants, mean value 5.0$\mu g m^{-3}$	32-100%
Carbon disulphide	0.03	[77,000]	-	2,600,000-times below limit	-
3-Methylpyridine	2.6	-	-		-
3-Vinylpyridine	8.3	-	0.1-4.0	Values as high as 8.4$\mu g m^{-3}$ observed in domestic setting for 3-vinylpyridine and ethenylpyridine combined	100%
Methylamine	1.2	[12,000]	-	10,000-times below limit	-

PM3006558461

Source: https://www.industrydocuments.ucsf.edu/docs/hnwj0001

CONSTITUENT	Calculated concentration in air (A) $\mu g\ m^{-3}$	Occupational exposure limit (Australia) $\mu g\ m^{-3}$	Observed indoor air concentration (B) $\mu g\ m^{-3}$	COMMENT	Probable contribution of ETS to observed level $\frac{Ax100}{B}$
Dimethylamine	0.5	[18,000]	-	36,000-times below limit	
Hydrazine	0.01	13	-	1,300-times below limit	-
N-Nitrosodimethylamine	0.02	-	0.02-0.03	Various office environments	67-100%
N-Nitrosopyrrolidine	0.004	-			-
N-Nitrosodiethylamine	<0.007	-	<0.01-0.03		23- >70%
PARTICULATE PHASE					
Particulate matter	596	[5,000]	0-1,088	8-times below limit Very large number of studies determining RSP	55-100%
Nicotine	70	500	0-199	7-times below limit Highest value includes cigar smoking. Values in offices usually 1-20μgm^{-3}. Nicotine absorbs onto surfaces rapidly	100% by definition

PM3006558462

Source: https://www.industrydocuments.ucsf.edu/docs/hnwj0001

TABLE 1(CONT'D iv)

CONSTITUENT	Calculated concentration in air (A) $\mu g\ m^{-3}$	Occupational exposure limit (Australia) $\mu g\ m^{-3}$	Observed indoor air concentration (B) $\mu g\ m^{-3}$	COMMENT	Probable contribution of ETS to observed level $\frac{Ax100}{B}$
Catechol	2.3	-	-		-
Hydroquinone	2.2	2,000	-	900-times below limit	-
Succinic acid	0.9	-	-		-
Lactic acid	1.0	-	-		-
Phenol	3.1	4,000		1,290-times below limit	-
Glycolic acid	0.9	-	-		-
Cholesterol	0.3	-	-		-
Benzoic acid	0.2	-	-		-
γ- Butyrolacetone	0.9	-	-		-
Anatabine	0.4	-	-		-
Harman	0.04	-	-		-

PM3006558463

Source: https://www.industrydocuments.ucsf.edu/docs/hnwj0001

TABLE 1(CONT'D v)

CONSTITUENT	Calculated concentration in air (A) $\mu g\ m^{-3}$	Occupational exposure limit (Australia) $\mu g\ m^{-3}$	Observed indoor air concentration (B) $\mu g\ m^{-3}$	COMMENT	Probable contribution of ETS to observed level $\frac{A}{B} \times 100$
Quinoline	0.1	-	-		-
N-Nitrosonornicotie (NNN)	0.04	-	-	In artificial environments where 11-18 cigarettes were smoked, NNN levels rose by n.d.-0.007$\mu g m^{-3}$	100% (by definition)
NNK	0.02	-	-	In artificial environments where 11-18 cigarettes were smoked, NNK levels rose by 0.002-0.01$\mu g m^{-3}$	100% (by definition)
Aniline	0.1	7,600	-	76,000-times below limit	-
2-Toluidine	0.04	[22,000]	-	550,000-times below limit	-
Cadmium	0.01	10	n.d.-0.003	1,000-times below limit 20 samples of indoor air environment	100%
Zinc	0.005	-	-		-
Nickel	0.01	[1,000]	0.001-0.01	100,000-times below limit 20 samples of indoor air environment	100%
N-nitrosodiethanolamine	0.0007	-	-		-

PM3006558464

Source: https://www.industrydocuments.ucsf.edu/docs/hnwj0001

TABLE 1 (CONT'D vi)

CONSTITUENT	Calculated concentration in air (A) $\mu g\ m^{-3}$	Occupational exposure limit (Australia) $\mu g m^{-3}$	Observed indoor air concentration (B) $\mu g\ m^{-3}$	COMMENT	Probable contribution of ETS to observed level $\frac{Ax100}{B}$
Benz[a]anthracene	0.002	[200]	(0.005)	100,000-times below limt No data for workplaces, only 3 restaurants	(40%)
Benzo[a]pyrene	0.001	[200]	n.d.-0.025	200,000-times below limit Many studies, few nominate workplace	4-100%
4-Aminobiphenyl	0.002	-	-		-
2-Naphthylamine	0.0007	-	-		-
PCDD's and PCDF's	0.00003	-	-		-

n.d. means not detected
RSP means respirable suspended particle matter

Occupational exposure limits are the time-weighted average (TWA) concentrations above which workers should not be exposed at any time during an 8 hour working day. Values were taken from "Exposure Standards for Atmospheric Contaminants in the Occupational Environment", National Occupational Health and Safety Commission, Australian Government Publishing Service, Canberra (May, 1995). Data in [parentheses] are from US OSHA, where no Australian data were available.

PM3006558465

Source: https://www.industrydocuments.ucsf.edu/docs/hnwj0001